Institute for Materials Science

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IMS Rapid Response 2017 * Recipient Guest Seminar

Professor Surya R. Kalidindi
George W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology, GA

Data Analytics for Mining Process-Structure-Property Linkages for Hierarchical Materials

Thursday, May 25, 2017
1:30 - 2:30
MSL Auditorium (TA-03 - Bldg 1698 - Room A103)

Abstract: A majority of the materials employed in advanced technologies exhibit hierarchical internal structures with rich details at multiple length and/or structure scales (spanning from atomic to macroscale). Collectively, these features of the material internal structure are here simply referred to as the material structure or just structure, and constitute the central consideration in the development of new/improved hierarchical materials. Indeed, the existence of a causal relationship between the material structure and its properties is the central tenet in the field of materials science and engineering. It should be noted that the word structure is used very broadly in these statements to include and refer to any of the details of the material internal structure (spanning all relevant length or structure scales involved). Although the core connections between the material's structure, its evolution through various manufacturing processes, and its macroscale properties (or performance characteristics) in service are widely acknowledged to exist, establishing this fundamental knowledge base has proven effort-intensive, slow, and very expensive for most material systems being explored for advanced technology applications. It is anticipated that the multi-functional performance characteristics of a material are likely to be controlled by a relatively small number of salient features in its hierarchical internal structure. However, cost-effective validated protocols do not yet exist for rapid identification of these salient features and establishment of the desired core knowledge needed for the accelerated design, manufacture and deployment of new materials in advanced technologies. The main impediment arises from lack of a broadly accepted framework for a rigorous quantification of the material's structure, and objective (automated) identification of the salient features that control the properties of interest. This presentation focuses on the development of data science algorithms and computationally efficient protocols capable of mining the essential linkages from large ensembles of materials datasets (both experimental and modeling), and building robust knowledge systems that can be readily accessed, searched, and shared by the broader community. The methods employed in this novel framework are based on digital representation of material's hierarchical internal structure, rigorous quantification of the material structure using n-point spatial correlations, objective (data-driven) dimensionality reduction of the material structure representation using data science approaches (e.g., principal component analyses), and formulation of reliable and robust process-structure-property linkages using various regression techniques. This new framework is illustrated through a number of case studies.

Biography: Surya Kalidindi received his B. Tech. in Civil Engineering from the Indian Institute of Technology in 1985 followed by his M.S. in Civil Engineering at Case Western Reserve University in 1988 and his Ph. D. in Mechanical Engineering from the Massachusetts Institute of Technology in 1992. Afterwards he joined the Department of Materials Science and Engineering at Drexel University as an Assistant Professor. In 2000, he was promoted to the Department Head. Under his leadership, the department grew to be ranked #10 nationally by Academic Analysts among Materials Science and Engineering programs in 2006. In 2013, Surya accepted his current faculty position in the Woodruff School of Mechanical Engineering at the Georgia Institute of Technology with joint appointments in Materials Science and Engineering and the School of Computational Science and Engineering. He serves as the Lead MGI/ICME Strategist for Georgia Tech's Institute for Materials.

Surya's research over the past two decades has made seminal contributions to the fields of crystal plasticity, microstructure design, spherical nanoindentation, and materials informatics. He has over 10,000 citations and an h-index of 61 according to google scholar. Surya has been elected a Fellow of TMS, ASM International, ASME, and Alpha Sigma Mu (Materials Honors Society). He has advised over 50 PhD students. Most recently, he and his group members were awarded the top prize ($25K USD) as well as one of the runner-up prizes ($5K USD) in the national Materials Science and Engineering Data Challenge sponsored by the Air Force Research Lab in partnership with the National Institute of Standards and Technology and the U.S. National Science Foundation.

To be on Professor Kalidindi's Agenda, to participate in the Early Career Lunch, or for general information contact:
Jordan S. Weaver * jordansweaver@lanl.gov * 667-5073

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